US007237650B2

(12) **United States Patent**
Casebolt

(10) **Patent No.: US 7,237,650 B2**
(45) **Date of Patent: Jul. 3, 2007**

(54) **TENSION DEVICE FOR USE WITH A SELF-RETRACTING LIFELINE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 625 days.

(21) Appl. No.: **10/848,905**

(22) Filed: **May 19, 2004**

(65) **Prior Publication Data**

US 2005/0269153 A1 Dec. 8, 2005

(51) **Int. Cl.**
A62B 1/08 (2006.01)
B65H 59/16 (2006.01)

(52) **U.S. Cl.** **182/231**; 188/65.2

(58) **Field of Classification Search** 182/231, 182/232, 234, 235, 236, 3, 36, 5, 73, 70; 188/266, 65.2–65.4; 254/377, 381–391, 254/405
See application file for complete search history.

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(57) **ABSTRACT**

A tension device for use with a self-retracting lifeline having a drum includes a lifeline and an elastic member. The lifeline has a retracting end, an intermediate portion, and a connecting end. The retracting end is operatively connected to the drum, and the connecting end is releasably connectable to a user. The elastic member interconnects the retracting end and the connecting end. The elastic member provides tension on the lifeline and prevents the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

20 Claims, 5 Drawing Sheets

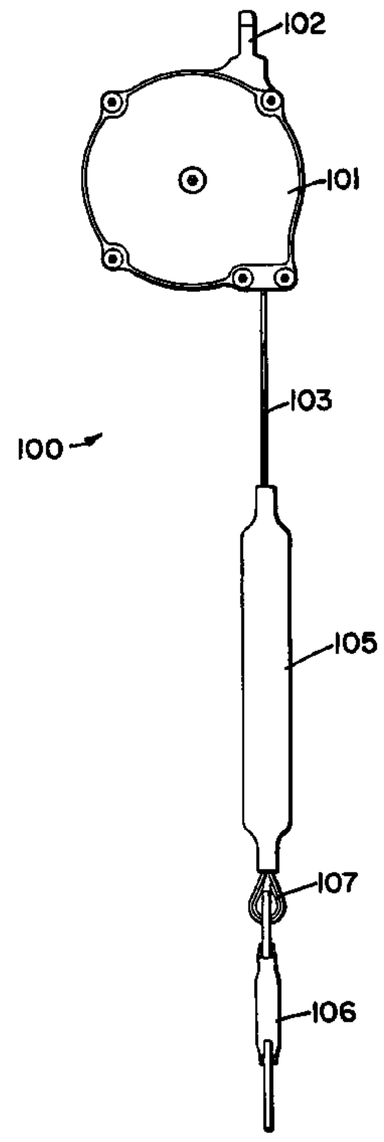


FIG. 1

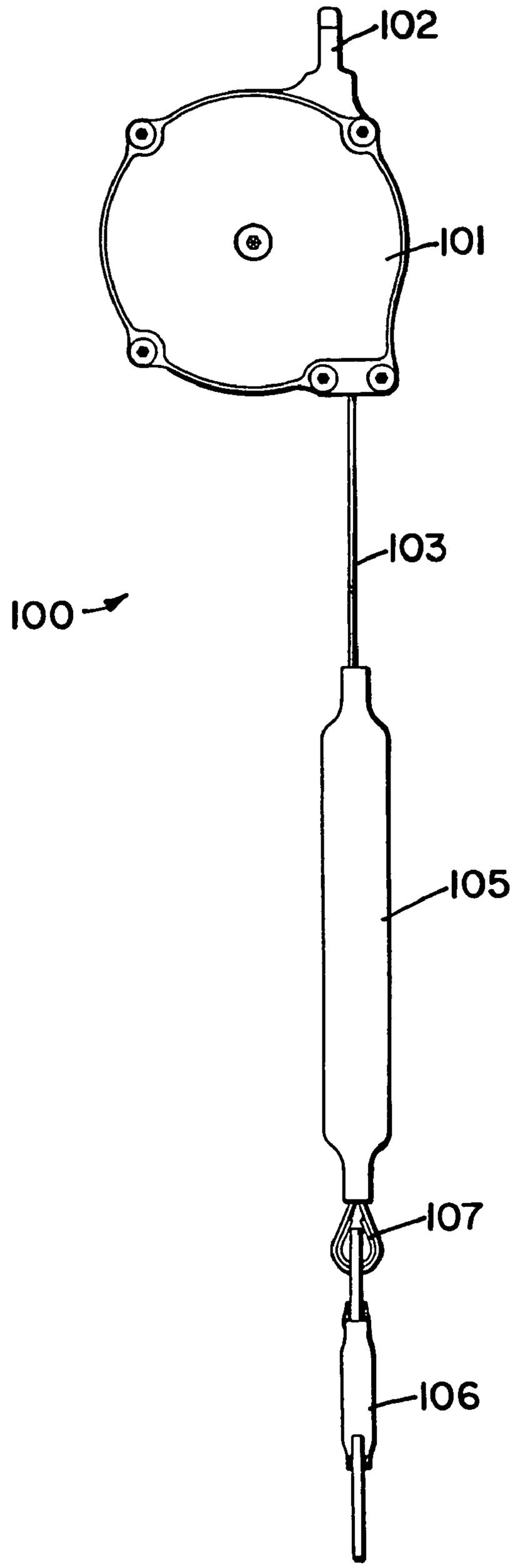


FIG. 2

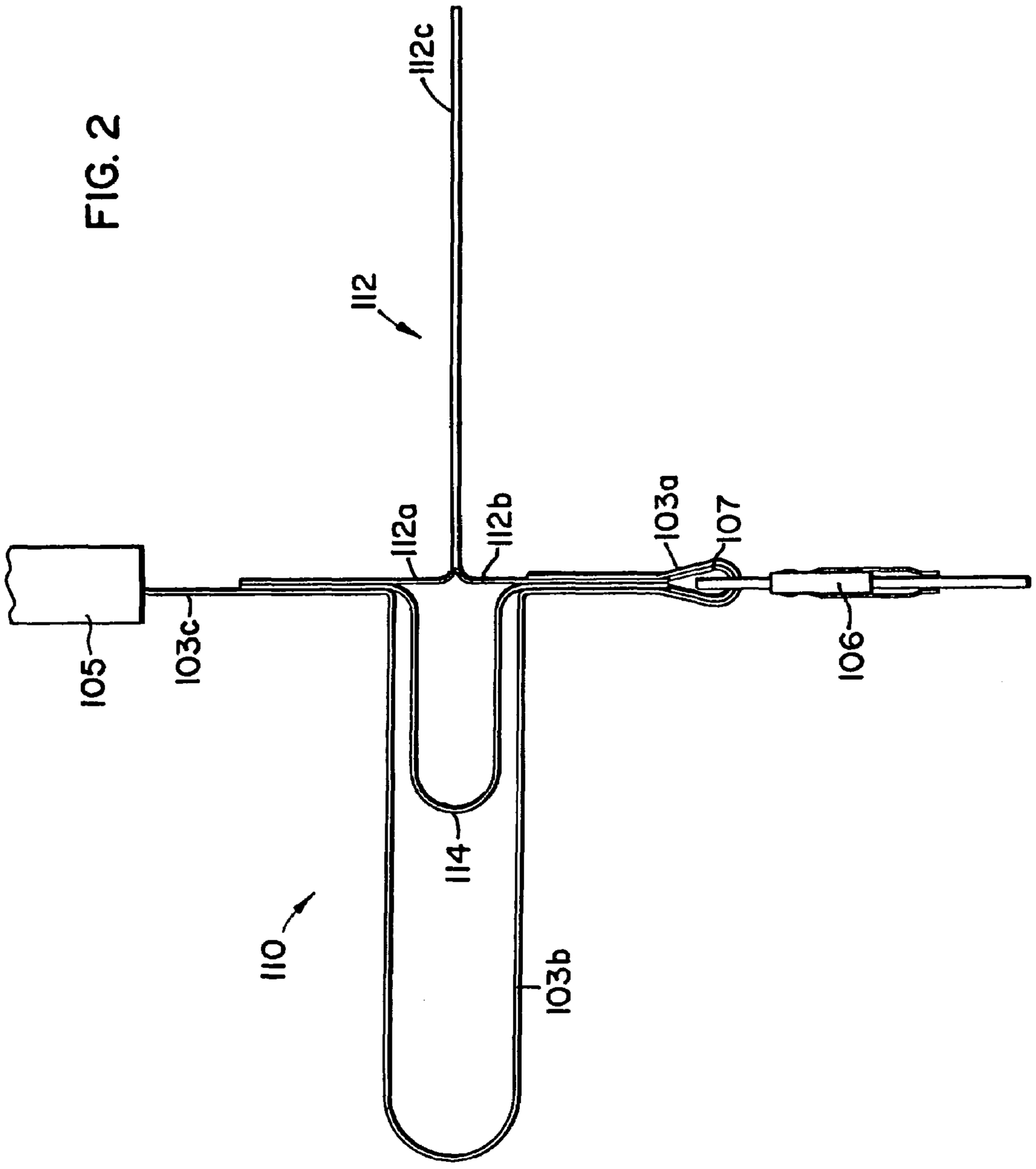


FIG. 3

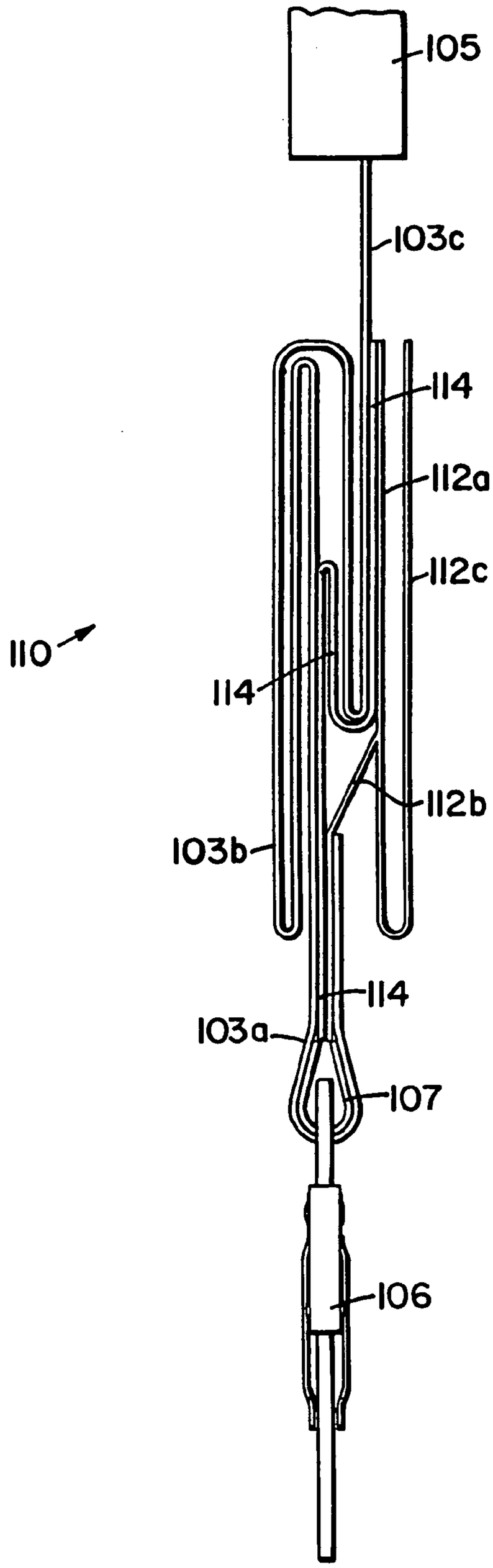


FIG. 4

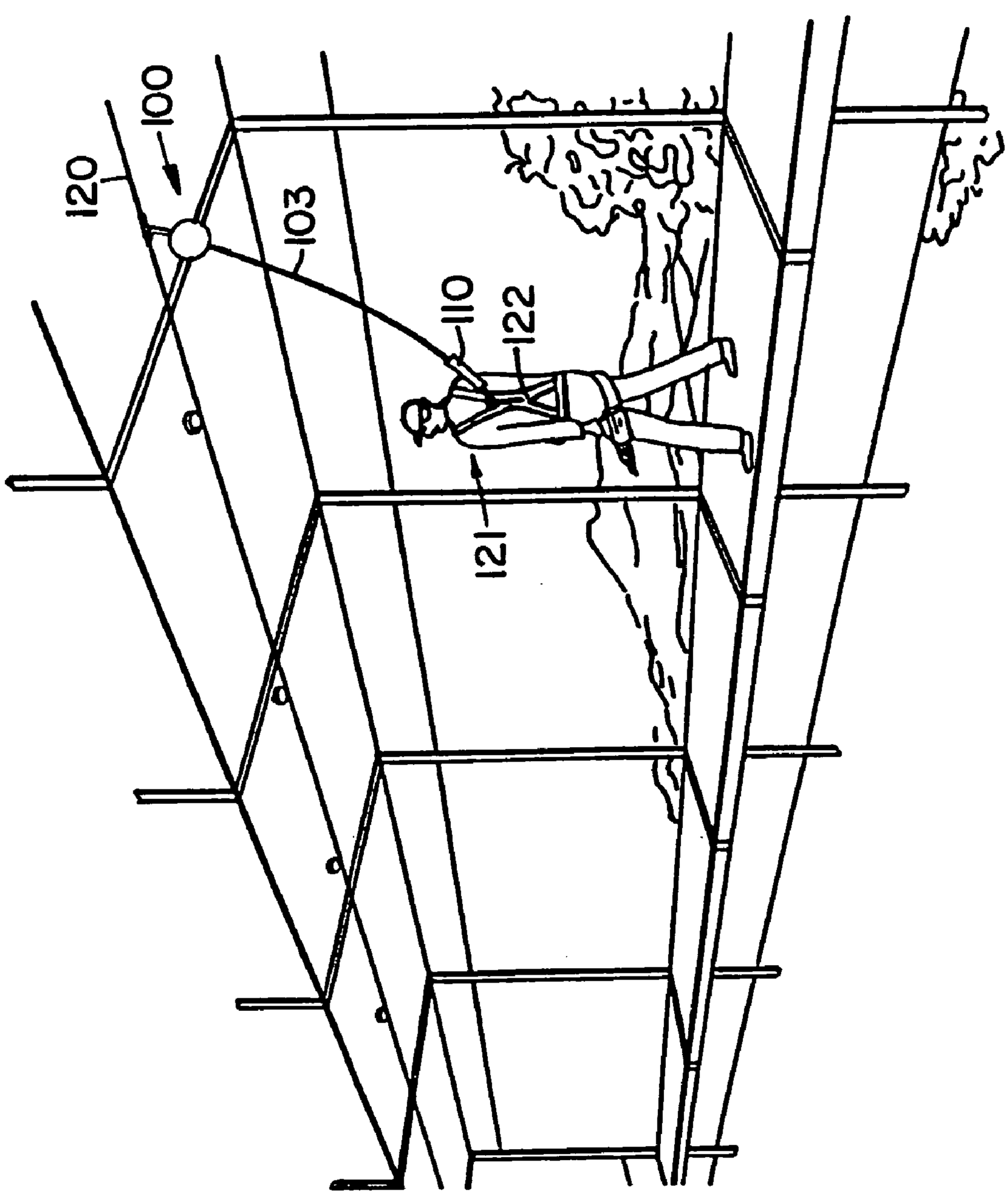
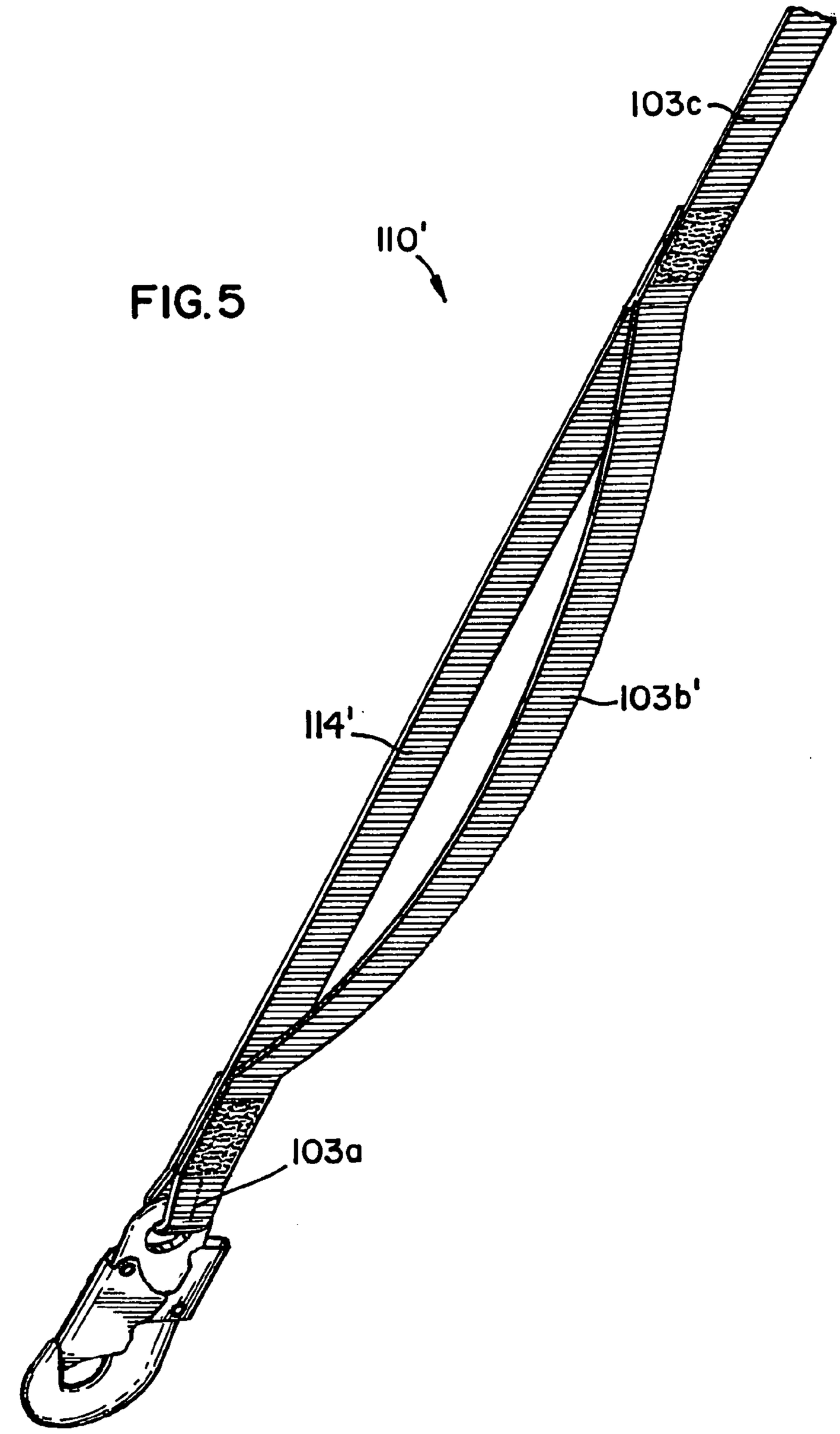


FIG.5



TENSION DEVICE FOR USE WITH A SELF-RETRACTING LIFELINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a tension device for use with a self-retracting lifeline.

2. Description of the Prior Art

Self-retracting lifelines are well known in the art of fall protection safety equipment for use by users performing tasks during which there is a risk a fall may occur. Self-retracting lifelines generally include a housing containing a drum around which a lifeline made of cable, rope, or webbing is wound. The drum is spring biased to pay out the lifeline as tension pulling the lifeline is applied and to retract any of the lifeline that has been unwound from the drum as the tension on the lifeline is reduced or released. In other words, the lifeline is paid out as the user moves away from the housing and the lifeline is retracted as the user moves toward the housing. The housing also includes a brake assembly for stopping rotation of the drum when the lifeline suddenly unwinds from the drum at a rate greater than a predetermined maximum angular velocity.

A self-retracting lifeline is typically connected to a support structure within the vicinity the user is performing the task, and the connecting end of the lifeline is typically connected to a safety harness worn by the user. The lifeline is easily drawn out of the self-retracting lifeline housing as the user moves away from the device, and the lifeline is automatically drawn back into the housing as the user moves toward the device. Should a fall occur, the brake assembly within the device is automatically engaged by a centrifugal clutch assembly, which stops the user's fall by gradually and quickly stopping the rotation of the drum. As the rotation of the drum is stopped, additional lifeline is prevented from being paid out of the housing to arrest the fall of the user.

During the fall, a ratcheting effect may occur. The term "ratcheting" in this context is a term used in the art to describe when the weight on the connecting end of the locked lifeline rebounds upward upon impact. The upward rebound releases the brake assembly thereby allowing the lifeline to be retracted and paid out, and the user will fall further until the brake assembly again stops the rotation of the drum. This ratcheting effect may occur several times during a fall.

A shock absorber may be operatively connected proximate the connecting end of the lifeline to dissipate the force should a fall occur. Once the lifeline of the self-retracting lifeline is locked by the brake assembly, the shock absorber reduces the force of the fall on the user. A typical shock absorber utilizes a tearing action to absorb the force as the fall of the user is arrested. Although the shock absorber reduces the force of the fall, the ratcheting affect may still occur during a fall.

SUMMARY OF THE INVENTION

A preferred embodiment tension device for use with a self-retracting lifeline including a drum includes a lifeline and an elastic member. The lifeline has a retracting end, an intermediate portion, and a connecting end. The retracting end is operatively connected to the drum and the connecting end is releasably connectable to a user. The lifeline includes slack proximate the intermediate portion. The elastic member interconnects the retracting end and the connecting end. The elastic member provides tension on the lifeline and prevents the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

A preferred embodiment self-retracting lifeline having a tension device includes a lifeline, a drum, a brake assembly, and an elastic member. The lifeline has a retracting end, an intermediate portion, and a connecting end. The connecting end is releasably connectable to a user. The lifeline includes slack proximate the intermediate portion. The retracting end of the lifeline is operatively connected to the drum and is wound about the drum. The drum is rotatable to pay out and retract the lifeline. The brake assembly engages the drum and prevents the drum from rotating during a fall thereby preventing the drum from paying out the lifeline. The elastic member interconnects the retracting end and the connecting end. The elastic member provides tension on the lifeline thereby preventing the brake assembly from releasing the drum and preventing the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

A preferred embodiment tension device for use with a self-retracting lifeline including a drum includes a lifeline and means for providing tension on the lifeline. The lifeline has a retracting end, an intermediate portion, and a connecting end. The retracting end is operatively connected to the drum and the connecting end is releasably connectable to a user. The means for providing tension on the lifeline interconnects the retracting end and the connecting end and prevents the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

A preferred embodiment tension device for use with a self-retracting lifeline including a drum includes a lifeline, an elastic member, and a shock absorber. The lifeline has a retracting end, an intermediate portion, and a connecting end. The retracting end is operatively connected to the drum and the connecting end is releasably connectable to a user. The lifeline includes slack proximate the intermediate portion. The elastic member interconnects the retracting end and the connecting end. The shock absorber interconnects the retracting end and the connecting end proximate the intermediate portion and the elastic member. The shock absorber includes a first portion and a second portion. The first portion and the second portion separate to absorb shock as the slack in the lifeline is reduced during a fall, and the elastic member provides tension on the lifeline and prevents the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a tension device constructed according to the principles of the present invention operatively connected to a self-retracting lifeline;

FIG. **2** is a side view of the components of an embodiment of the tension device shown in FIG. **1**;

FIG. **3** is a side view of the components of the tension device shown in FIG. **2** arranged to fit within a sleeve;

FIG. **4** is a perspective view of the tension device shown in FIG. **1** in use; and

FIG. **5** is a side view of the components of another embodiment of the tension device shown in FIG. **1**.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

A preferred embodiment tension device for use with a self-retracting lifeline constructed according to the principles of the present invention is designated by the numerals **110** and **110'** in the drawings.

As shown in FIG. **1**, a self-retracting lifeline **100** includes a housing **101** having a connecting member **102** through which a connector (not shown) such as a hook may be used to connect the housing **101** to a support structure. The housing **101** is configured and arranged to contain a drum (not shown) around which a lifeline **103** is wound. The drum is spring biased to pay out the lifeline **103** as tension pulling the lifeline **103** is applied and to retract any of the lifeline **103** that has been unwound from the drum as the tension on the lifeline **103** is reduced or released. The housing **101** also includes a brake assembly (not shown) for stopping rotation of the drum when the lifeline **103** suddenly unwinds from the drum at a rate greater than a predetermined maximum angular velocity. Preferably, a sleeve **105** contains either the tension device **110** or the tension device **110'** proximate the connecting end of the lifeline **103**. The sleeve **105** also acts as a stop to prevent the lifeline **103** from being completely retracted into the housing **101**. A hook **106** is operatively connected to the connecting end of the lifeline **103**, and the hook **106** is configured and arranged to connect to a safety harness donned by a user.

Although it is recognized that any suitable self-retracting lifeline known in the art may be used with the present invention, examples of possible self-retracting lifelines that may be used with the present invention are disclosed in U.S. Pat. Nos. 4,877,110 and 5,186,289, which are incorporated by reference herein. As shown in FIG. **4**, the self-retracting lifeline **100** interconnects a support structure **120** such as a horizontal lifeline and a user **121** donning a harness **122**. The lifeline **103** is connected to the harness **122**, and the tension device **110** is operatively connected to the lifeline **103** proximate the user **121**. The lifeline **103** includes a connecting end **103***a*, an intermediate portion **103***b*, and a retracting end **103***c*. A hook **106** is operatively connected to the connecting end **103***a* and is releasably connectable to a user. The end of the connecting end **103***a* is preferably inserted through an opening in the hook **106** and secured to the portion of the connecting end **103***a* on the opposite side of the hook **106**, preferably by stitching. A wear pad **107**, which is preferably a piece of webbing, may be used. The wear pad **107** protects the lifeline **103** against wear from rubbing on the hook **106**. The retracting end **103***c* is operatively connected to the drum of the self-retracting lifeline **100**.

In one embodiment, the tension device **110** includes an elastic member **114** that interconnects the connecting end **103***a* and the retracting end **103***c*, as shown in FIGS. **2** and **3**. One end of the elastic member **114** is connected to the retracting end **103***c*, preferably by stitching, and the other end is connected to the connecting end **103***a*, also preferably by stitching. The elastic member **114** is shorter in length than the intermediate portion **103***b*. The elastic member **114** is preferably made of a piece of elongate elasticized material such as elastic or rubber. The elastic member **114** could also be a spring or a resilient cord, and the elastic member **114** is preferably capable of stretching approximately 170% to 190%+/−20%. It is recognized that any suitable material known in the art may be used, and the elastic member **114** may be made of one or more layers of material.

The tension device **110** also includes an optional shock absorber **112**, which includes a first portion **112***a* and a second portion **112***b*. One end of the first portion **112***a* is connected to the retracting end **103***c* proximate the intermediate portion **103***b*, preferably by stitching, and one end of the second portion **112***b* is connected to the connecting end **103***a* proximate the intermediate portion **103***b*, also preferably by stitching. The end of the elastic member **114** and the end of the second portion **112***b* are preferably secured to the connecting end **103***a* between the layers of the connecting end **103***a* preferably sewn together to secure the hook **106** thereto. The other ends of the first portion **112***a* and the second portion **112***b* are preferably interwoven or sewn together with stitching thereby forming an interconnected portion **112***c* proximate the intermediate portion **103***b* of the lifeline **103**. Preferably, the interwoven fibers or the stitching of the interconnected portion **112***c* are torn thereby separating the first portion **112***a* and the second portion **112***b* when subjected to a fall, which reduces the arresting forces of the fall. The shock absorber **112** preferably helps keep the fall arresting forces under 900 pounds.

The lifeline **103** includes slack proximate the intermediate portion **103***b*. When the interconnected portion **112***c* of the shock absorber **112** is intact, the slack in the lifeline **103** is created by the shock absorber **112**. Because the interconnection of the connecting end **103***a* and the retracting end **103***c* by the shock absorber **112** is shorter in length than the elastic member **114** and the intermediate portion **103***b*, the slack is created in the elastic member **114** and in the lifeline **103** proximate the intermediate portion **103***b*. Preferably, the combined length of the portions **112***a* and **112***b* after separation of the interconnected portion **112***c* into portions **112***a* and **112***b* is approximately equal to the length of the intermediate portion **103***b* and the length of the fully stretched elastic member **114**.

After the shock absorber **112** has separated during a fall, the elastic member **114** provides tension in the lifeline **103** proximate the intermediate portion **103***b*. The slack, which is reduced, is then created by the elastic member **114**. Even though the amount of slack may vary as the elastic member **114** stretches and contracts, the elastic member provides tension on the lifeline **103** even though there is also varying slack in the lifeline **103**. The elastic member **114** preferably has enough retraction tension over great enough distance to prevent the drum from retracting the lifeline **103**. In other words, the elastic member **114** keeps tension in the lifeline **103**, and this tension force is greater than the retraction force so that the elastic member **114** pulls downward on the lifeline **103** more than the force upon impact pulls upward on the lifeline **103** proximate the connecting end **103***a* so that the retracting end **103***c* will not retract into the housing **101** of the self-retracting lifeline **100** upon impact to unlock the lifeline **103**. This tension on the lifeline **103** prevents the ratcheting effect from occurring. The elastic member **114** has an elasticity such that the tension on the lifeline **103**, a downward force on the retracting end **103***c*, is greater than an upward force on the elastic member **114** from the rebounding connecting end **103***a* during a fall.

Preferably, the interconnected portion **112***c* extends from one side of the lifeline **103**, and the elastic member **114** and the intermediate portion **103***b* extend from the other side of the lifeline **103**, the elastic member **114** preferably inside the intermediate portion **103***b*, as shown in FIG. **2**. As shown in FIG. **3**, the tension device **110** may be folded so that it can be contained in a sleeve **105**, which is preferably made of shrink tubing. The sleeve **105** may then be slid in place about the folded tension device **110**. Once the sleeve **105** is placed about the tension device **110**, the ends of the sleeve **105** are shrunk to envelope and contain the tension device **110**.

In another embodiment, as shown in FIG. **5**, the tension device **110'** includes an elastic member **114'**. The tension device **110'** is similar to the tension device **110** but does not

include a shock absorber. Both tension devices **110** and **110'** are configured and arranged to fit within the sleeve **105** as shown in FIG. **1**. One end of the elastic member **114'** is connected to the retracting end **103***c*, preferably by stitching, and the other end is connected to the connecting end **103***a*, also preferably by stitching. Because the elastic member **114'** is shorter in length than the intermediate portion **103***b'*, slack is created in the lifeline **103** proximate the intermediate portion **103***b'* by the elastic member **114'**. As the elastic member **114'** is stretched and extended, the slack in the lifeline **103** is reduced, and as the elastic contracts and shortens to resume its unextended length, the slack in the lifeline **103** is increased.

Even though the amount of slack may vary as the elastic member **114'** stretches and contracts, the elastic member **114'** provides tension on the lifeline **103** even though there is also varying slack in the lifeline **103**. The elastic member **114'** preferably has enough retraction tension over great enough distance to prevent the drum from retracting the lifeline **103**. In other words, the elastic member **114'** keeps tension in the lifeline **103**, and this tension force is greater than the retraction force so that the elastic member **114'** pulls downward on the lifeline **103** more than the force upon impact pulls upward on the lifeline **103** proximate the connecting end **103***a* so that the retracting end **103***c* will not retract into the housing **101** of the self-retracting lifeline **100** upon impact to unlock the lifeline **103**. This tension on the lifeline **103** prevents the ratcheting effect from occurring. The elastic member **114'** has an elasticity such that the tension on the lifeline **103**, a downward force on the retracting end **103***c*, is greater than an upward force on the elastic member **114'** from the rebounding connecting end **103***a* during a fall.

In operation, when a fall occurs, the brake assembly engages the drum and prevents the drum from rotating during the fall thereby preventing the drum from paying out the lifeline **103**. The sleeve **105** remains in place and covers/protects the tension device **110** or **110'**. The sleeve **105** does not interfere with the operation of the tension device **110** or **110'** or restrict the extension of the lifeline **103** resulting from a fall. If the tension device **110** including the shock absorber **112** is used, the interconnected portion **112***c* of the shock absorber **112** begins to separate and absorb some of the shock from the fall. The interconnected portion **112***c* is separated into the first portion **112***a* and the second portion **112***b* as the slack in the elastic member **114** and some of the slack in the lifeline **103** proximate the intermediate portion **103***b* are reduced. After the interconnected portion **112***c* of the shock absorber **112** has separated, the elastic member **114** keeps tension on the lifeline **103** when any slack proximate the intermediate portion **103***b* of the lifeline **103** develops. The elastic member **114** of the tension device **110** provides tension on the lifeline **103** and prevents the brake assembly from releasing the drum, which prevents the drum from retracting the lifeline **103** when the connecting end of the lifeline **103** rebounds in an upward direction during the fall.

If the tension device **110'** is used, the elastic member **114'** keeps tension on the lifeline **103** when any slack proximate the intermediate portion **103***b'* of the lifeline **103** develops. The elastic member **114'** of the tension device **110'** provides tension on the lifeline **103** and prevents the brake assembly from releasing the drum, which prevents the drum from retracting the lifeline **103** when the connecting end of the lifeline **103** rebounds in an upward direction during the fall.

Although some lifelines may have some degree of elasticity and this elasticity may prevent some degree of ratcheting effect from occurring, this device will significantly reduce the slack that may otherwise develop in the lifeline resulting from rebounds should a fall occur.

The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

I claim:

1. A tension device for use with a self-retracting lifeline including a drum, comprising:

a) a lifeline having a retracting end, an intermediate portion, and a connecting end, the retracting end adapted to be operatively connected to the drum, the connecting end being operatively connected to a connector that is releasably connectable to a user, the lifeline including slack proximate the intermediate portion; and

b) an elastic member interconnecting the retracting end and the connecting end, the elastic member providing tension on the lifeline and preventing the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

2. The tension device of claim **1**, further comprising a sleeve in which the intermediate portion and the elastic member are contained.

3. The tension device of claim **1**, wherein the slack in the lifeline is created by the elastic member.

4. The tension device of claim **1**, further comprising a shock absorber interconnecting the retracting end and the connecting end proximate the intermediate portion and the elastic member, wherein the slack in the lifeline is created by the shock absorber.

5. The tension device of claim **4**, wherein the shock absorber includes a first portion and a second portion, the first portion and the second portion separating to absorb shock as the slack in the lifeline is reduced during a fall.

6. The tension device of claim **1**, wherein the elastic member has an elasticity such that the tension on the lifeline is greater than an upward force on the elastic member from the rebounding connecting end during a fall.

7. A self-retracting lifeline having a tension device, comprising:

a) a lifeline having a retracting end, an intermediate portion, and a connecting end, the connecting end being operatively connected to a connector that is releasably connectable to a user, the lifeline including slack proximate the intermediate portion;

b) a drum, the retracting end of the lifeline being operatively connected to the drum and being wound about the drum, the drum being rotatable to pay out and retract the lifeline;

c) a brake assembly engaging the drum and preventing the drum from rotating during a fall thereby preventing the drum from paying out the lifeline; and

d) an elastic member interconnecting the retracting end and the connecting end, the elastic member providing tension on the lifeline thereby preventing the brake assembly from releasing the drum and preventing the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

8. The self-retracting lifeline of claim **7**, wherein slack in the lifeline is created by the elastic member.

9. The self-retracting lifeline of claim **7**, further comprising a shock absorber interconnecting the retracting end and the connecting end proximate the intermediate portion and

the elastic member, wherein the slack in the lifeline is created by the shock absorber.

10. The self-retracting lifeline of claim **9**, wherein the shock absorber includes a first portion and a second portion, the first portion and the second portion separating to absorb shock as the slack in the lifeline is reduced during a fall.

11. The self-retracting lifeline of claim **7**, wherein the elastic member has an elasticity such that the tension on the lifeline is greater than an upward force on the elastic member from the rebounding connecting end during a fall.

12. A tension device for use with a self-retracting lifeline including a drum, comprising:

a) a lifeline having a retracting end, an intermediate portion, and a connecting end, the retracting end adapted to be operatively connected to the drum, the connecting end being operatively connected to a connector that is releasably connectable to a user; and

b) means for providing tension on the lifeline interconnecting the retracting end and the connecting end and preventing the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

13. The tension device of claim **12**, wherein the lifeline includes slack proximate the intermediate portion created by the means for providing tension.

14. The tension device of claim **12**, wherein the means for providing tension is an elastic member.

15. The tension device of claim **14**, further comprising a shock absorber interconnecting the retracting end and the connecting end proximate the intermediate portion and the elastic member, wherein the lifeline includes slack proximate the intermediate portion created by the shock absorber.

16. The tension device of claim **15**, wherein the shock absorber includes a first portion and a second portion, the first portion and the second portion separating to absorb shock as the slack in the lifeline is reduced during a fall.

17. A tension device for use with a self-retracting lifeline including a drum, comprising:

a) a lifeline having a retracting end, an intermediate portion, and a connecting end, the retracting end adapted to be operatively connected to the drum, the connecting end being operatively connected to a connector that is releasably connectable to a user, the lifeline including slack proximate the intermediate portion;

b) an elastic member interconnecting the retracting end and the connecting end; and

c) a shock absorber interconnecting the retracting end and the connecting end proximate the intermediate portion and the elastic member, the shock absorber including a first portion and a second portion, the first portion and the second portion separating to absorb shock as the slack in the lifeline is reduced during a fall, and the elastic member providing tension on the lifeline and preventing the drum from retracting the lifeline when the connecting end of the lifeline rebounds in an upward direction during a fall.

18. The tension device of claim **17**, wherein the slack in the lifeline is created by the shock absorber.

19. The tension device of claim **17**, further comprising a sleeve in which the intermediate portion of the lifeline, the elastic member, and the shock absorber are contained.

20. The tension device of claim **17**, wherein the elastic member has an elasticity such that the tension on the lifeline is greater than an upward force on the elastic member from the rebounding connecting end during a fall.

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